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Indian Standard

TEXTILE FABRICS — ABRASION RESISTANCE — METHODS FOR DETERMINATION

भारतीय मानक

टेक्सटाइल कपड़े — अपघर्षण प्रतिरोध — ज्ञात करने की पद्धति

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Physical Methods of Test Sectional Committee, TXD 1

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards on 20 April 1989, after the draft finalized by the Physical Methods of Test Sectional Committee had been approved by the Textile Division Council.

Several factors such as bending, stretching, tearing, abrasion, laundering and cleaning contribute to the wear performance or durability of fabrics. Abrasion which is just one aspect of wear is caused by the rubbing of the component fibres and yarns of the fabric.

The nature of abrasion met within the actual use of a fabric is of different type and severity. Therefore, it is virtually impossible to imitate them exactly in any one laboratory test. In addition, the conditions of abrasion operating on different types of fabrics are so different that a single type of abrasion test to assess the relative durability of each is not feasible.

The type of abrasion test suitable for a given fabric depends on the assessment of the relative importance of factors that can be anticipated as being more involved during service (such as, rubbing or flexing).

The approach followed here is, therefore, to subject a fabric to such type of abrasion and determine whether one fabric will probably outlast another in similar and specified end use. For instance, the durability of a newly developed fabric can be compared with an already accepted fabric.

Laboratory assessment of abrasion resistance of a fabric can be affected by many variable factors, namely, nature of abradant, tension on test specimens, pressure between abradant and test-specimens, direction and speed of the abradant motion, removal of lint and other debris, and judgement of operator when a visual end point is used. Variation in these abrasion conditions can easily cause a larger deviation in test results than that due to the difference among samples, thus invalidating the results of an entire test. Hence, the abrasion resistance results obtained by different operators and in different laboratories may show a high degree of variability and the precision of this method is uncertain. Considerable caution is, therefore, required in interpreting the results of abrasion tests which cannot be relied upon for comparing fabrics of widely different fibre compositions or construction.

This standard is expected to eliminate, as far as possible, variations in testing procedures for the determination of abrasion resistance of woven and knitted fabrics

In reporting the results of a test made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

TEXTILE FABRICS — ABRASION RESISTANCE — METHODS FOR DETERMINATION

1 SCOPE

1.1 This standard prescribes methods for the determination of resistance of textile fabrics to plane abrasion (flat abrasion) and flex abrasion.

1.2 Except for floor covering fabrics, the methods prescribed in this standard are applicable to all textile fabrics, irrespective of their composition (that is whether the fabric is made of cotton, wool, silk, jute or man-made fibres or a blend of two or more such fibres) and history (that is, the manufacturing processes involved and the finishing treatments).

1.3 In the case of narrow fabrics, only flex abrasion resistance shall be determined.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard.

IS No.	*Title*
IS 1324 : 1966	Glossary of textile terms relating to man-made fibre and fabric industry (*first revision*)
IS 2364 : 1987	Glossary of textile terms — woven fabrics (*second revision*)
IS 3919 : 1987	Methods for sampling cotton fabrics for determination of physical characteristics
IS 6359 : 1971	Methods for conditioning of textiles

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions in addition to those given in IS 1324 : 1966 and IS 2364 : 1987 shall apply.

3.2 Abrasion

The wearing away of any part of a material by rubbing against another surface.

3.3 Plane Abrasion

The abrasion of the material from flat area.

3.4 Flex Abrasion

Rubbing accompanied by flexing and bending.

3.5 Edge Abrasion

Abrasion similar to the one occurring at collars and folds.

4 SAMPLING

Sample from the lot shall be drawn so as to be representative of the lot. Sample drawn in accordance with the relevant material specification or as agreed to between the buyer and the seller shall be held to be representative of the lot In the absence of above, the procedure given in IS 3919 : 1966 may be followed.

5 ATMOSPHERIC CONDITIONS FOR CONDITIONING AND TESTING

5.1 Prior to test, the fabric shall be conditioned to moisture equilibrium from the dry side, in the standard atmosphere of 65 ± 2 percent relative humidity and 27 ± 2°C temperature as prescribed in IS 6359 : 1971.

5.2 The test shall be carried out under standard atmospheric conditions.

6 CHOICE OF METHOD

Any one of the methods may be used for determination of abrasion resistance of fabric depending upon the material specification or agreement between the parties, about the type of the instruments, facilities available and character of testing desired, such as, plane abrasion or flex abrasion.

7 DETERMINATION OF PLANE ABRASION RESISTANCE

7.0 General

Although plane abrasion of fabric surface does not necessarily cover all aspects of strains which are important in determining service life, there are occasions when such a test gives useful information. Plane abrasion resistance shall be determined using one of the two commercially available testers (*see* Annex A and B) by Method 1 and 2.

7.1 Method 1

7.1.1 *Principle*

Circular specimens of fabric are abraded under known pressure on an apparatus giving a motion which is the resultant of two simple harmonic motions at right angles to each other. The resistance to abrasion is estimated by breakage of threads or by loss in mass of the specimens.

7.1.2 *Apparatus*

The abrasion tester is described in Annex A.

NOTE — The apparatus specified in this test was designed to give a controlled amount of abrasion between fabric surfaces at comparatively low pressure in continuously changing directions.

7.1.3 *Test Specimen Preparation*

Cut or punch four circular specimens of 38 mm diameter for the breakage method of assessment and eight specimens for the loss in mass method of assessment.

7.1.4 *Test Procedure*

7.1.4.1 Mount test specimen on a 38 mm diameter circular piece of foam placed in the specimen holder. Keep the specimen under tension by pressing the holder against the brass plate provided on the base of the apparatus and screw it up tightly.

7.1.4.2 Mount a new piece of abradant on each of the four tables with a piece of felt, as specified, beneath the abradant. Keep the abradant under tension by placing a weight on its surface before tightening up the retaining frame. Replace the abradant at the start of each test and after 50 000 rubs, if the test is continued beyond this number.

7.1.4.3 Clamp the specimen holders on the moving plate under the desired load and switch on the machine.

NOTE — Normally a total load of 125 g/cm^2 is used but a lower load of 30 g/cm^2 may be used if agreed to between the buyer and the seller.

7.1.5 *Choosing of the End-Point*

7.1.5.1 Estimate the resistance to abrasion either by abrading till two threads break or by loss in mass of the specimens, as has been agreed to between the buyer and the seller.

7.1.5.2 *Breakage of threads*

Continue abrading the specimens until two threads are broken, rounding each reading to the nearest 1 000 rubs. Record the number of rubs required before breakage occurs. In some cases, removal of surface nap or other stage is a more appropriate end-point and this should be used, if agreed to between the buyer and the seller.

7.1.5.3 *Average rate of loss in mass*

Abrade two specimens to end-point as described in **7.1.5.2** to get approximate idea of abrasion resistance of the sample and further pairs of specimens to three intermediate stages of approximately 25, 50 and 75 percent of the estimated abrasion resistance value choosing the convenient numbers of rubs from the range 100, 250, 500, 1 000, 1 500, 2 000, 2 500, 5 000, 7 500, 10 000 and 15 000. Recondition the specimens and weigh to the nearest 1 mg.

7.1.5.4 Plot a graph between the loss in mass and the number of rubs. If the points lie in a straight line, draw a line and determine the average rate of loss in mass in mg/1 000 rub. If the points lie in curve, draw a curve and read off the loss in mass at three convenient points chosen from the suitable range.

7.1.6 *Report*

The report shall include the following information:

a) Description of the material tested;
b) Type of abradant used;
c) Pressure used and the criterion for judging the end point;
d) Average of rubs to specified end points; and
e) If applicable, the average rate of loss in mass or the loss in mass at three stages, taken from a smooth curve through the points.

7.2 Method 2

7.2.1 *Principle*

Abrasion resistance of a specimen held in a fixed position and supported by an inflated rubber diaphragm is determined by rubbing either unidirectionally or multidirectionally against a standard abradant.

7.2.2 *Apparatus*

The abrasion tester is described in Annex B.

7.2.3 *Test Specimen Preparation*

Cut five circular test specimens of 112 mm in diameter, taking care to avoid specimens from areas containing the same wales or courses in knitted fabrics or the same warp and weft yarns in woven fabrics.

7.2.4 *Procedure*

7.2.4.1 Place the specimen over the rubber diaphragm in a smooth condition and clamp the specimen in place without distorting it.

7.2.4.2 Place the abrasive paper or other abradant on the abradant plate under sufficient tension to be held smooth and in such a position that the contact pin, reaching through a hole in the abradant, is even with the surface of the abradant.

NOTES

1 In the absence of any specific material specifications zero emery polishing paper should be used as the abradant.

2 If the continuous changing abradant head is used, it should be noted that, although the weight of the head is counter balanced, the balance changes during use as the paper passes from the back roll to the front roll.

7.2.4.3 Set the air pressure under the diaphragm and load on the abradant plate. In the absence of any specific material specifications, the air pressure should be 0·3 kg/cm^2 (4 p. s. i.) and the load on the abradant should be 454 g. Ensure that the air pressure control and contact between the inflated specimen and loaded abradant is in a state of equilibrium before abrasion is started. To ensure consistent inflation of the diaphragm, inflate to a higher air pressure (25 percent) and then reduce to testing pressure.

7.2.4.4 If unidirectional abrasion is desired, disengage the rotation mechanism of the specimen clamp and bring the specimen into the desired direction by turning and setting the clamp after the diaphragm has been inflated.

7.2.4.5 In the event that multidirectional abrasion is required, or if no specific indication as to the abrasion direction is given in the fabric specification, engage the rotation mechanism of the specimen clamp.

7.2.4.6 Remove pills of matted fibres interfering with proper contact between specimen and abradant during the test if they cause a marked vibration of the abradant plate.

7.2.4.7 If the specimen slips in the clamp or the air pressure does not remain constant during the test or an anomalous wear pattern is obtained, discard such individual measurements and test an additional specimen.

7.2.5 *Choosing of the End-Point*

7.2.5.1 *Breakage of threads*

Abrade the specimen until all fibres in the centre of the abraded area are worn off so that the diaphragm and the abradant head come into contact and the instrument automatically stops.

7.2.5.2 *Removing a predetermined thickness of the material*

Abrade the specimen using the electrical depth micrometer to determine the automatic end-point for removing a predetermined thickness of the material from the specimen as agreed to between the buyer and the seller.

NOTES

1 For testing coated fabrics as well as plastic and rubber sheeting which are considered to be worn out, when they become permeable to air, a diphragm with a hole in the centre is used. As soon as sufficient surface material has been worn off from the specimen to permit air leakage the inflated specimen collapses and the machine is automatically stopped.

2 Stiff materials and materials with irregular contours such as fibre-glass fabrics, stiff pile fabrics, etc, are tested by assembling specimens with two diaphragms, the outer diaphragm with a large hole enabling contact between the specimen and the abradant plate.

3 Unless the continuous changing abrasion head is used, it is recommeneded that the abradant paper be changed after every 300 cycles.

7.2.6 *Report*

The report shall include the following information:

a) Type of abradant,

b) Type of abrasion (unidirectional or multidirectional), and

c) Number of cycles to reach the end point as determined by electrical contact.

8 DETERMINATION OF FLEX ABRASION RESISTANCE

8.1 Principle

A specimen of the fabric is subjected to unidirectional reciprocal folding and rubbing over a bar having specified characteristics under known conditions of pressure and tension to evaluate the flex abrasion resistance.

8.2 Description of Apparatus

A tester as specified in the Annex C shall be used.

8.3 Test Specimen Preparation

8.3.1 Unless and otherwise specified by a material specification or by an agreement between the purchaser and the seller, five test specimens shall be tested.

8.3.2 Cut the test specimen 200 mm long and of 32 or 38 mm width depending on whether the number of yarns/dm of the specimen is below or above 200. Ravel the specimen to 25 mm in width by removing from each side approximately the same number of yarns. Do not take two specimens for the warp test from the same warp ends or any two specimens for the weft test from the same picks. Take weft specimens at sufficiently wide intervals, whenever possible, to ensure the inclusion of yarn from different cops.

8.4 Procedure

8.4.1 After positioning the bar by means of the yoke holder, place the specimen between the pressure (upper) plate and the reciprocating (lower) plate of the apparatus and locate centrally. With the specified folding bar of folding blade inserted, after being clamped and loaded by removal of the yoke holder, distribute the tension exerted by the bar or blade uniformly over the width of the specimen and align the long dimension both above and below the bar parallel to the direction of the reciprocating motion. Position the specimen with the fold at the centre (midpoint) of the upper plate, and the reciprocating plate at the rear of its stroke when the specimen is clamped.

8.4.2 Load the pressure plate and folding bar or blade as required by the material specification. In the absence of the material specification, it is recommended that bar load sufficient to produce rupture in excess of at least 1C0 cycles and preferably 300 cycles be used, in combination with the lowest head load (pressure) (*see* Note) sufficient to prevent vibration of the upper plate at the start of the test. A ratio of bar to head loads of 4 : 1 is recommended.

NOTE — A low level of load is required to prevent rippling of the fabric during testing. This rippling is caused by a high degree of friction between the fabric and the bar when abnormally high loads are applied and results in insufficient relative motion between the bar and the fabric specimen under test.

8.4.3 Check the bar alignment after the first 25 cycles by noting whether the bar has shifted laterally to either side of its normal rest position. If such shifting occurs, discard the specimen and make the proper adjustment.

8.4.4 Remove the pills of matted fibre debris interfering with proper contact between the specimen and the folding bar or folding blade during the test if they cause a marked vibration of the pressure plate or otherwise interfere with proper abrasion. The pills should preferably be removed by careful clipping. Do not attempt to correct the vibration of the pressure plate due to pilling by applying additional load. Check the position of the specimen after additional cycles to ensure that the removal of pills has not altered the bar alignment.

8.4.5 If the specimen slips in the clamps or tension and pressure upon the folded specimen do not remain constant during the test, or an anomalous wear pattern is obtained, disregard such individual measurements and test an additional specimen.

8.4.6 Before the new blade is used, rinse it with a degreasing agent. Repeat this after every specimen is run. Also wipe the pressure plate with tissue saturated in the solvent.

8.4.7 Determine the end point by one of the following methods as given in **8.4.8** or **8.4.9**.

8.4.8 *Failure*

Abrade the specimen until ruptured.

8.4.9 *Percentage Loss in Breaking Load*

Abrade the specimen a specified number of cycles and determine the breaking load using ravelled strip or cut strip procedure. The abraded area of the specimen should be placed midway between the clamps of the machine. Compare this breaking load with the breaking load determined under the same conditions on an unabraded portion of the same sample. Calculate the loss in breaking load and report to the nearest 1·0 percent using the formula:

Percentage loss in breaking load

$$= \frac{100\,(A - B)}{A}$$

where

A = breaking load before abrasion, and

B = breaking load after abrasion.

8.5 Report

The report shall include the following information:

a) Abradant used, bar or blade;

b) Average number of cycles required to rupture the specimen, reported as follows:

Total Number of Cycles	*Report to the Nearest Cycle*
Below 200	10
200 to 999	25
1 000 to 4 999	50
5 000 and above	100

c) Average percentage loss of breaking strength after abrasion for one or more specified number of cycles; and

d) Tension and pressure used.

ANNEX A

(*Clauses* 7.0 *and* 7.1.2)

PLANE ABRASION TESTER

A-1 DESCRIPTION OF APPARATUS

A-1.1 The abrasion tester is shown in Fig. 1 and 2.

A-1.2 P is the brass plate resting on three supports A, B and C. Each support consists of a single ball bearing, about 16 mm in diameter, moving freely in a brass cup. There is a machined steel wearing plate in each cup and all three are co-planar. By this means the plate is enabled to glide about easily in the approximately horizontal plane determined by the three point supports. On the lower side of the plate are three steel plates machined flat and co-planar which provide upper wearing surface for the ball bearings. The plate is given the resultant movement of two simple harmonic motions at right angles in such a way that every point on it traces out a path known as Lissajous figure (*see* Fig. 3). This is the result of the relative motion of two outer pegs (X and Y) which are synchronized and driven at the same speed of 47·5 ± 2 rev per min while the inner peg(s) rotate(s) at a slightly lesser speed than the outer pegs with the speeds in the ratio of 30 : 32. The total stroke of outer pegs as well as inner pegs is 60·5 mm.

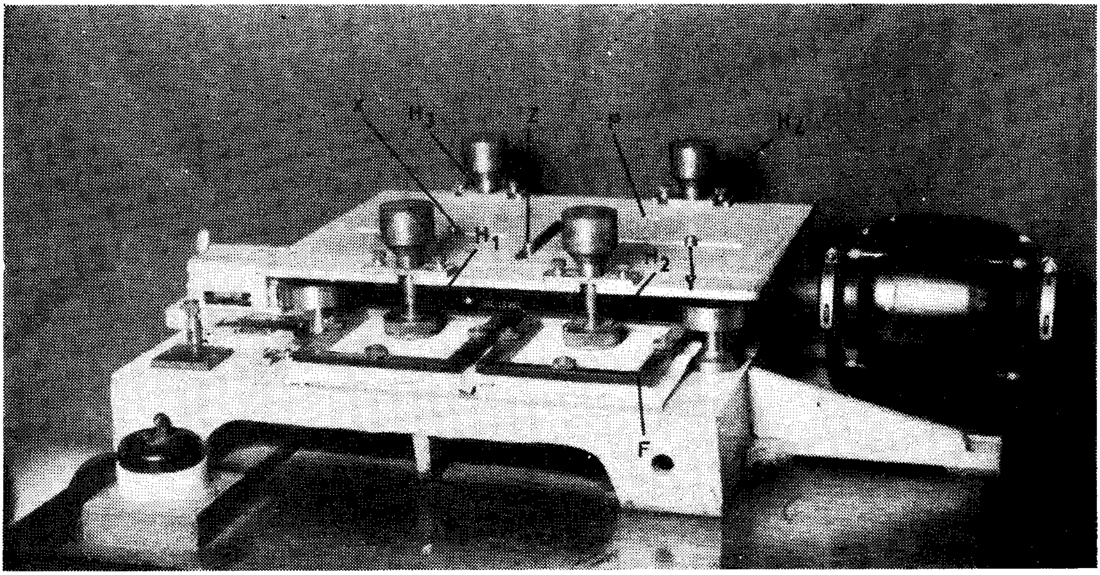

FIG. 1 PLANE ABRASION TESTER (WITH BRASS PLATE)

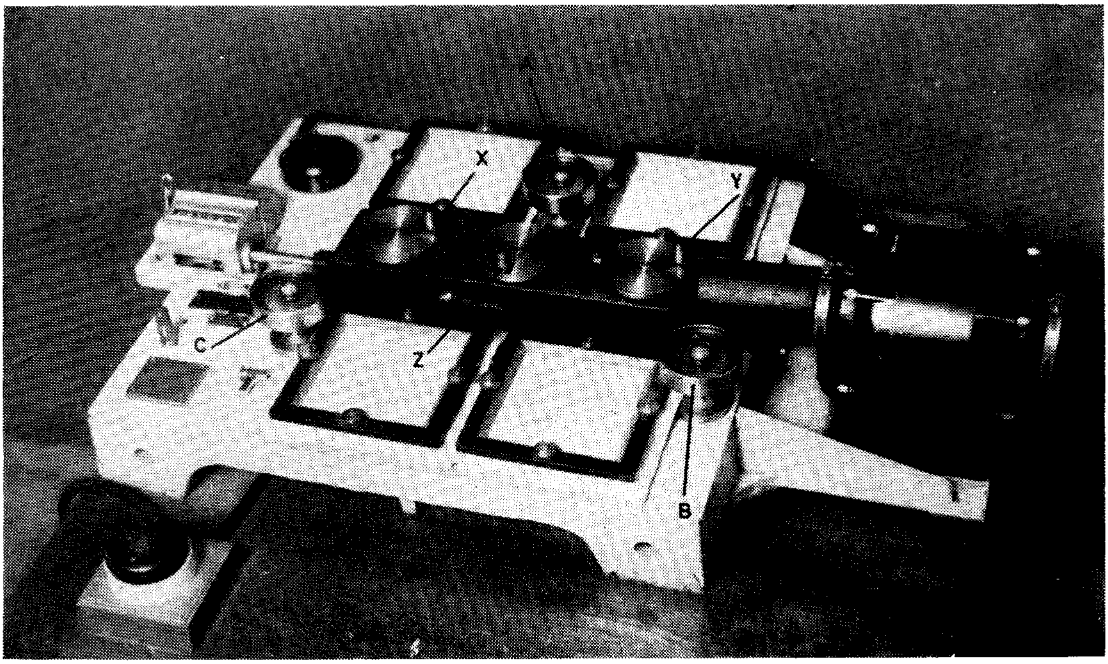

FIG. 2 PLANE ABRASION TESTER (WITHOUT BRASS PLATE)

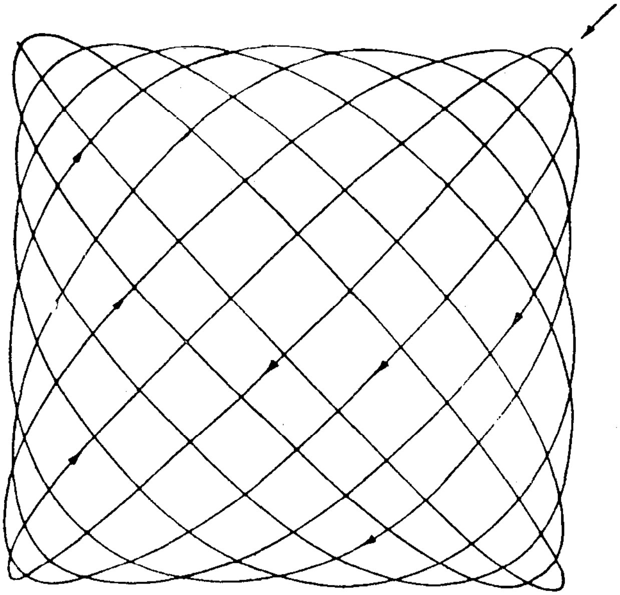

FIG. 3 LISSAJOUS FIGURE TRACED BY PLATE (PLANE ABRASION TESTER)

A-1.3 There are recesses on two sides of the plate into which the four specimen holders (H_1, H_2, H_3 and H_4) can be fitted. Each of the specimen holder rests upon one of the four small abrading tables whose surfaces are also flat and parallel to the plane in which the plate glides. These have the freedom of movement in vertical plane but must take part in the horizontal movement of the plate. The cloth specimens in the holders are rubbed on one of the surfaces of the abrading table, the path of each being the Lissajous figure.

A-2 BACKING FOR SPECIMENS

A-2.1 Four circular pieces (38 mm diameter) of polyurethane foam approximately 3 mm thick and of density approximately 0·04 g/cm^3 are used for backing the specimens. These are renewed when they become worn or soiled with use.

A-3 CLOTH SPECIMEN HOLDER

A.3.1 Each specimen holder consists of three parts, *A*, *B* and *C* (Fig. 4). *A* is a ring into which the cloth disc *D*, 38 mm in diameter, fits exactly. The working area of specimen holder is 6·45 cm^2. *B* is a kind of circular plunger which is put in on top of the cloth and *C* is screwed down over the outside of *A*. It then squeezes the plunger against the rim of *A*, gripping the cloth and as the plunger *B* protrudes slightly through *A*, the cloth is tensioned. In order to obtain a satisfactory tension, the specimens are mounted by pressing the holder down against the flat surface of the brass plate provided in the base of the apparatus. A loaded specimen holder is shown in Fig. 5. With this device, the specimens may be removed at any stage of abrasion testing and weighed. They can easily be put back into the holders for further rubbing exactly the same portion of the cloth being exposed.

A-3.2 The machine makes about 3 000 rubs/hr (one rub being a complete revolution of each cloth holder) and is fitted with a revolution counter and switch to stop the machine after a predetermined number of rubs.

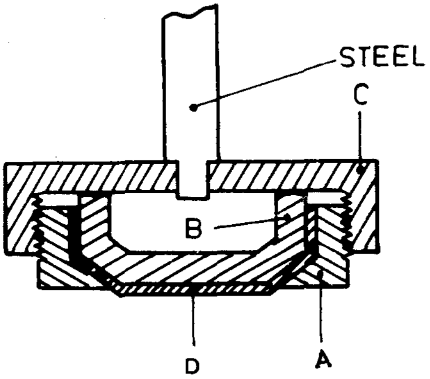

FIG. 4 CLOTH SPECIMEN HOLDER (PLANE ABRASION TESTER)

A-4 ABRADING TABLE

A-4.1 There are four square abrasion tables, one for each specimen holder. They are made of cast iron and machined flat. The surface against which the 38 mm disc is to be rubbed shall be the abrasive fabric specimen or zero emery polishing paper as has been agreed to between the buyer and the seller.

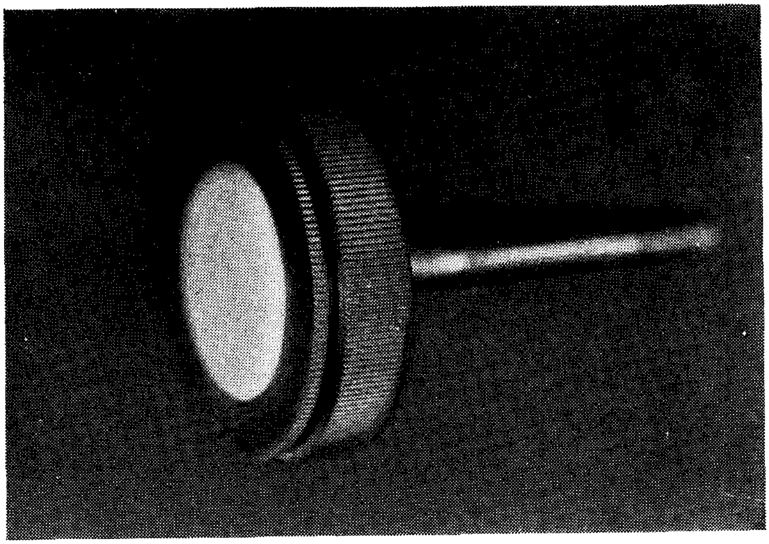

FIG. 5 LOADED SPECIMEN HOLDER (PLANE ABRASION TESTER)

A-4.2 The load on cloth specimens is adjusted to be in the range of 30 to 125 g/cm² by adding suitable weights to the top of the peg which projects through the plate.

A-4.3 The abrasive is normally mounted on the square abrasion tables of the machine over a piece of woven felt of mass 575 to 675 g/m² and approximately 1·3 mm thick which need not be renewed until soiled or damaged.

A-4.4 The standard abrasive fabric of 125 mm² is laid on a abrasion table with a piece of felt as specified beneath the abradant. Place a heavy weight with a flat smooth surface on it. Then gently pull apart the opposite edges of the cloth to remove any creases. The weight holds the abrasive fabric firmly whilst a square retaining frame *F* in Fig. 1 is put over the edges of the tightened fabric. Remove the weight and the cloth will be found to be firmly covering the table, as in Fig. 2. A series of serrations on the lower side of the brass frame-work prevents the felt and fabric from slipping and working loose.

A-4.5 It has been found by experience that any difference in tension, either in specimen holder or abrading cloth, are not sufficiently large to affect the results to any appreciable extent provided that the setting is done correctly, as described above.

A-5 METHOD OF RUBBING

A-5.1 When the machine is running, the discs are rubbed over the surface on the abrading table, following the path shown in Fig. 3. At one stage, the path followed is the arc of a circle but this gradually changes and progressively alters through a series of narrowing portions of ellipses until the motion is in a straight line along the diagonal of the figure. As the motion continues, it develops, again through the same portions of ellipses (which are, however, now described in the opposite direction) until the circular motion is again produced. This cycle of operations is repeated for as long as desired.

A-5.2 This type of motion has the advantage that the pattern under examination is rubbed in all the directions, not merely warp or weft way. The motion is continually altering so that the fibres of the cloth are continually being flexed in all directions and not merely in one direction.

ANNEX B

(*Clauses* 7.0 *and* 7.2.2)

PLANE ABRASION TESTER

B-1 DESCRIPTION OF APPARATUS

The plane abrasion tester shown in Fig. 6 consists of the following parts.

B-1.1 Surface Abrasion Head

The specimen is mounted in a circular clamp over a rubber diaphragm by means of a clamping ring and a tightening collar. The circular opening of the clamping ring is 94·0 ± 1·3 mm in diameter and that of the collar 95·3 mm or more. The height from the surface of the clamped in specimen to the upper edge of the tightening collar shall not exceed 9·5 mm. The clamping area of the body of the clamp and the ring should have gripping surfaces to prevent slipping of the specimen and leakage of air pressure during the test. Means should be provided for applying air pressure to the body of the clamp so that the pressure under the diaphragm can be controlled between 0 and 0·4 kgf/cm^2 with an accuracy of ± 5 percent.

B-1.2 Diaphragm

The rubber diaphragm should be 1·40 ± 0·25 mm in thickness. A metallic contact pin 3·2 mm in diameter is sealed into the centre of the diaphragm flush with the diaphragm surface. Provision should be made for a flexible electrical connection from this contact pin to the ground of the machine. The strain distribution on the diaphragm must be uniform so that when inflated without the specimen, it assumes the shape of a sphere.

B-1.3 Driving Mechanism

The design of the driving mechanism is such that the circular clamp makes a reciprocal motion of 115 ± 15 double strokes per minute of 25 mm stroke length. Provision should be made for the rotation of the clamp in addition to the reciprocating motion so that one revolution can be completed in not less than 50 and not more than 100 double strokes.

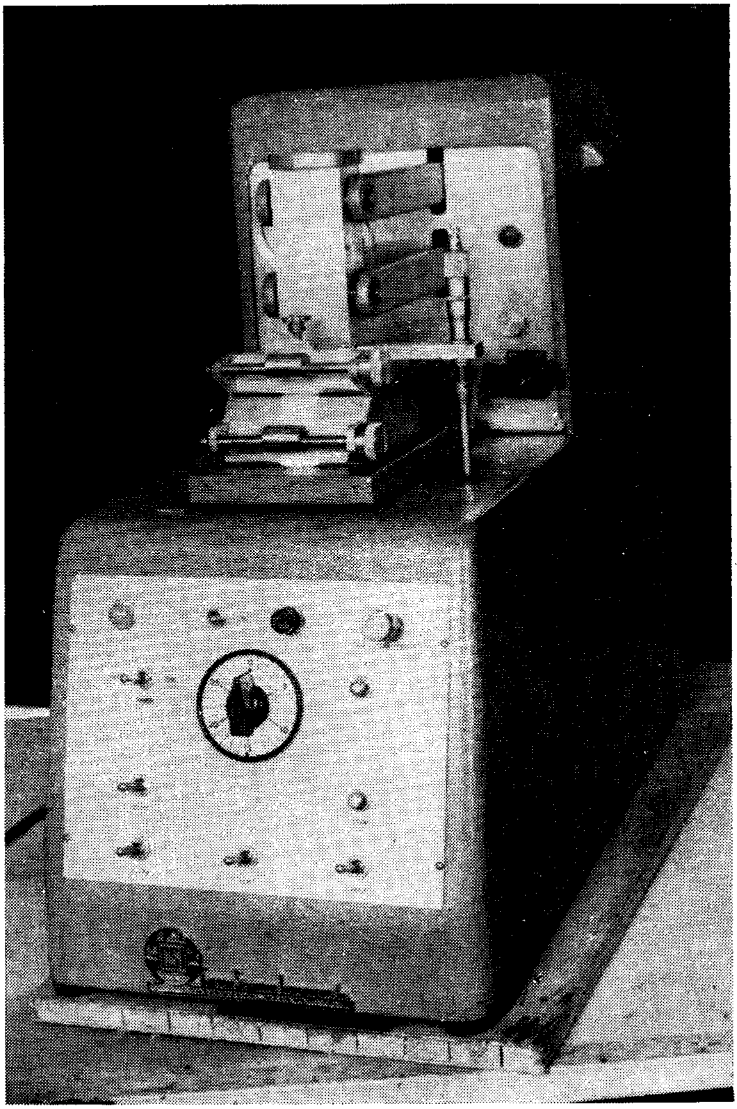

FIG. 6 PLANE ABRASION TESTER

B-1.4 Balance Head and Abradant Plate

B-1.4.1 The abradant is mounted upon a plate, which is rigidly supported by double-lever parallelogram to provide for free movement in a direction perpendicular to the plane of the reciprocating specimen-clamp. The abradant plate assembly should be well balanced to maintain a vertical pressure equivalent to a mass of 0 to 2 270 g dead weights. Provision should be made to mount different abradants, such as, abrasive paper, fabrics, etc, on this plate, and to stretch them into an even position. An electrically insulated contact pin, adjustable to the thickness of the abradant is mounted into this plate on the length axis at one of the turning points of the centre of the clamp.

B-1.4.2 The inflated diaphragm tester can also be equipped with a continuous changing abradant head which is available from the machine manufacturer.

B-1.5 Machine Stopping Mechanism

Contact between the adjustable pin on the lower side of the abradant plate and the contact pin inserted into the centre of the diaphragm closes a low voltage circuit and stops the machine.

B-1.6 Indicator

Means should be provided for indicating the diaphragm pressure and the number of abrasion cycles (1 cycle = 1 double stroke).

ANNEX C

(*Clause* 8.2)

FLEX ABRASION TESTER

C-1 DESCRIPTION OF APPARATUS

The flex abrasion tester has the following essential parts.

C-1.1 Balance Head and Flex Block Assembly

The assembly should be of two parallel, smooth plates, one of which makes a reciprocating motion of 115 ± 15 double strokes per minute, of 25 mm stroke-length. The other plate is rigidly supported by a double lever assembly to provide free movement in a direction perpendicular to the plate of the reciprocating plate. This plate is stationary during the test and must be well balanced so that a vertical load can be maintained by means of dead weights. The plates are equipped with clamps to permit the specimen, after it has been folded around the bar, to be aligned with its long dimension parallel to the axis of the reciprocal motion and equidistant from the edges of the plates. The clamps have gripping surfaces adequate to prevent slipping of the specimen during the test.

C-1.2 Flexing Bar Blade

C-1.2.1 A bar or blade is fixed depending on the specification. Flex bars with the tester have been standardized.

C-1.2.2 The flex bars should be of 1·6 ± 0·4 by 11·2 ± 1·6 mm cross section. It should be made of tool steel tipped with an edge of cemented carbide or other highly wear resistant material. The top, bottom and the edge of the bar which will be in contact with the specimen, should be finally finished by grinding and polishing, which levels off the microscopic projections without breaking the edges of the bar.

C-1.2.3 The folding blade should be made of tool steel 0·3 ± 0·13 mm by 25·4 ± 1·6 mm in cross section, having radius of curvature of 0·13 ± 0·02 mm and well polished. The bar and blade should be of such length to properly fit the yoke (tension device) employed.

C-1.2.4 Before a new unstandardized bar or blade is used for testing, it should be placed in the tester and receive to at least 20 000 cycles of abrasion using a 64-mm fabric strip under a tension of 2 270 g. A plied yarn grey cotton duck, weighing from 400 to 500 g/m^2 is a suitable fabric strip for this purpose. The bar or blade should then be standardized by comparing its abrasion level to that of a master standard bar or blade reserved for standardization purposes only. This comparison should be carried out on a fabric with highly uniform abrasion resistance, preferably a plain weave fabric. Where the abrasion level of the bar or blade differs by more than ± 10 percent from the level of the master standard bar or blade, the bar or blade should be reground or otherwise reworked until its abrasion level is within ±10 percent of that of the master standard.

C-1.2.5 The testing bar should be restandardized on a regular schedule either weekly or monthly depending upon the amount of use of the given testing bar. Where the abrasion level of the bar or blade differs by more than ±10 percent from the level of the master standard bar or blade, the bar or blade should be reground or otherwise reworked until the abrasion level is within ±10 percent of that of the master standard bar or blade. The same fabric should be used for restandardization as was used for initial standardization. A standardized fabric is available from the equipment manufacturer.

C-1.3 Tension Device (Yoke)

A means for applying force to the folding bar or blade, with the force acting parallel to the surface of the two plates and perpendicular to the fold of the specimen to produce a tension evenly distributed across the fold of the specimen. The bar or blade should be prevented from tilting or rotating around its principal axis by providing means for rigidly clamping the bar to the yoke. The bar yoke used for applying tension to the bar must be sufficiently rigid to prevent its distortion, with consequent impairment of bar position, during handling and specimen loading.

C-1.4 Yoke-Positioning Device

Means should be provided to position the bar and yoke properly while loading the specimen, in order to maintain the proper bar alignment and to remove the positioning device from contact with the yoke after the specimen has been loaded and before the start of the test. Proper bar alignment is a critical factor in this test and is regulated by the length of the cables attaching the yoke to the loading platform. The proper alignment should be checked by abrading a strip of fabric and noting whether the bar shifts laterally to either side of normal rest position during the course of abrasion. Such shifting is indicative of improper bar alignment and should be adjusted by shortening or lengthening the proper cable until the shifting is no longer observed. After the proper cable length has been achieved, the cables should be clamped securely by means of locknuts to prevent subsequent change in length.

C-1.5 Machine Stopping Mechanism

A microswitch actuated by the weight rack stops the machine when the test specimen ruptures.

C-1.6 Indicator

Means are provided for indicating the number of cycle (1 cycle = 1 double stroke).

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.